

Creating a Demand-Side Resources Industry within PJM

Vincent J. Cushing
Updated; May 16, 2005

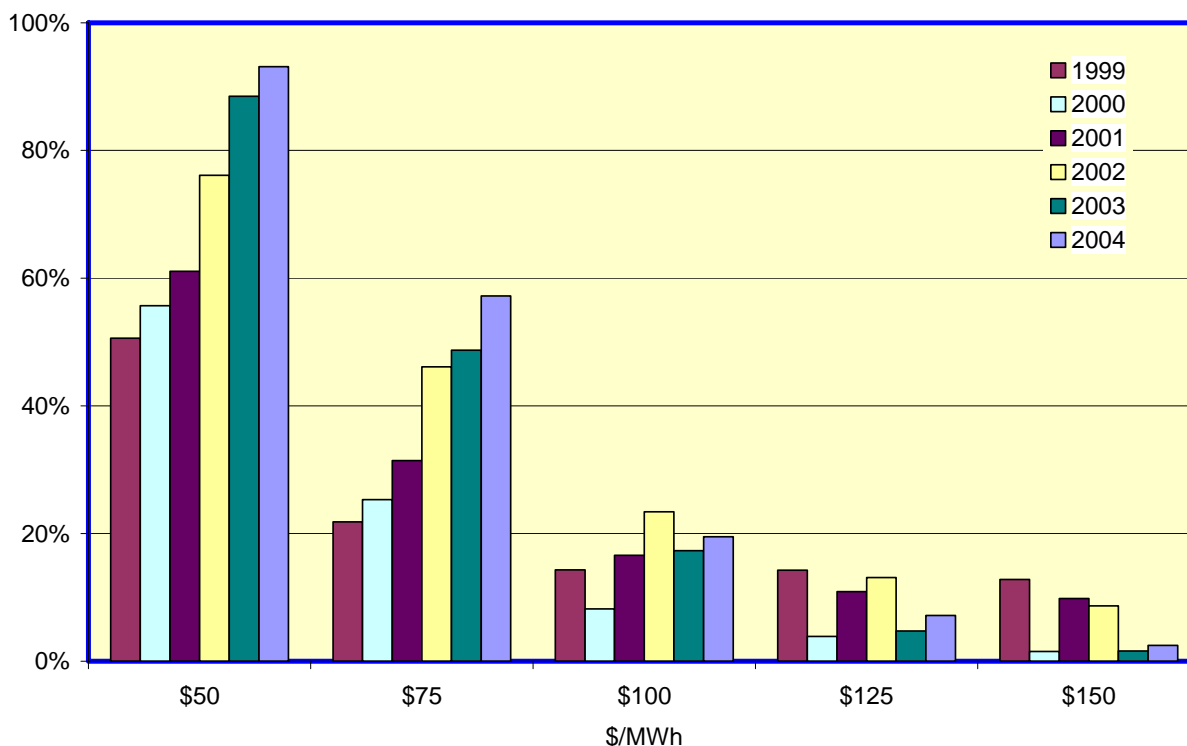
This discussion paper supports four conclusions:

- High energy prices have occurred with increasing frequency in PJM over the last six years – providing an ever increasing opportunity for demand-side resources (“DSR”) in PJM.
- The DSR industry has not kept pace with the opportunity.
- The DSR industry requires a different rigor in its development. DSR is not generation.
- To achieve its potential, the DSR needs a showcase program and requires better organization and coordination within PJM than exists currently. The very small recognition of DSR in PJM’s proposed Reliability Pricing Model (“RPM”) provides a timely example.

High energy prices have occurred with increasing frequency

Figure 1: Frequency of High Prices Occuring in PJM

(% of summer days that prices exceed each threshold)



\$75 is a significant locational marginal price threshold because the PJM Economic Demand Response Program provides a large incentive to retail customers for shifting or curtailing load from such hours. Figure 1 indicates that such prices have occurred with increasing frequency for the last five years. While Figure 1 focuses on the summer, the growth and opportunity is even more impressive in the winter months. For example, in the winter 2004, prices exceeded \$75 on 76% of the days.

Demand-side resources have not kept pace

A robust demand response is largely absent from electricity markets, yet it is an important means of moderating prices. Fortunately, getting a level of demand response sufficient to counteract price run ups is not insurmountable. Studies indicate that we need only about 5 to 10% of demand to be effective. I believe that good market operation will require this.”

– William L. Massey, Commissioner, FERC, September 2002

FERC, NARUC, and others have cited 5 to 10% as a target. In contrast, participation in PJM programs in 2004 was barely measurable. Table 10 is excerpted from the PJM Market Monitors recent report to the Federal Energy Regulatory Commission. It summarizes DSR activity for the period January through July 2004. On an annual basis, total program credits gross up to approximately \$2,000,000. After disbursements to participating customers, this is not enough business to keep even one DSR provider in business, much less support an entire industry. To the credit of APS, PPL, and PENELEC, eighty-six percent of the participation in these programs during 2004 came from western PJM zones. Less than \$200,000 (annualized) are attributable to the eastern PJM zones that have a looming capacity shortage and the greatest need.

Table 10: 2004 Economic Program Zonal Reductions									
	Real- Time			Day- Ahead			Pilot		
	MWh	Credits	Hours	MWh	Credits	Hours	MWh	Credits	Hours
AECO	0	\$0	0	0	\$0	0	0	\$0	0
APS	26,019	\$766,790	2,034	0	\$0	0	106	\$10,142	52
BGE	141	\$6,746	75	0	\$0	0	0	\$0	0
COMED	0	\$0	0	0	\$0	0	0	\$0	0
DPL	13	\$817	19	179	\$7,961	50	0	\$0	0
JCPL	12	\$1,420	10	0	\$0	0	187	\$21,595	97
METED	57	\$480	96	0	\$0	0	375	\$36,682	83
PECO	15	\$1,389	16	0	\$0	0	0	\$0	0
PENELEC	0	\$0	0	0	\$0	0	938	\$87,353	45
PEPCO	0	\$0	0	0	\$0	0	0	\$0	0
PPL	2,861	\$77,227	296	0	\$0	0	14	\$1,263	47
PSEG	803	\$76,707	1,203	0	\$0	0	0	\$0	0
RECO	0	\$0	0	0	\$0	0	0	\$0	0
Total									
	29,920	\$931,577	3,749	179	\$7,961	50	1,620	\$157,034	324

Source: “Assessment of PJM Load Response Programs (Revised)”, PJM Market Monitoring Unit, October 31, 2004.



The lack of participation in the day-ahead economic program suggests a missed opportunity for PJM and for retail customers. Currently, this program does not appear to be achieving its objectives.

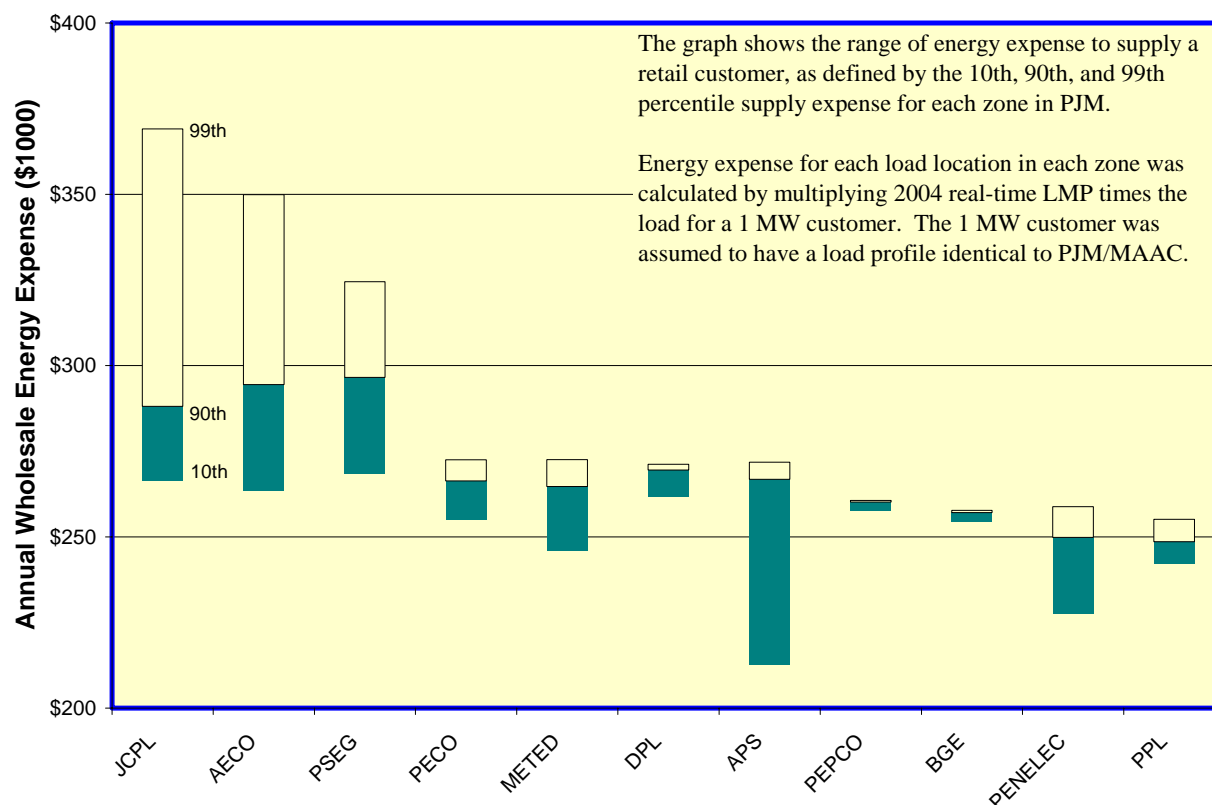
A fourth program – the PJM Emergency Demand Response Program – had no transactions during the report period. This program only pays if resources are actually deployed by PJM. The lack of transactions simply reflects the appropriate contracting of DSR's capacity role in a surplus capacity market.

DSR requires a different rigor in its development

DSR rigor can take a number of forms.

First, different energy markets derive different value from DSR. Conventional wisdom would support that DSR provides more bang for the buck in energy, capacity, and ancillary service markets with high prices, price volatility, and congestion, as these markets are the low-hanging fruit. Figure 2 suggests that DSR programs should broadly solicit participation in New Jersey and should be graded by their development and performance in that market. More selective opportunities exist in other zones and need to be specifically identified and developed. (Newer PJM zones are not shown in Figure 2 because they have been part of PJM for less than a year. As an indication, based on May-December data only, the annual wholesale energy expense to serve a 1 MW customer in the ComEd zone is approx. 75% of that in the PPL zone and has an extremely narrow expense range.)

Figure 2: Where can DSR provide the most value?



Second, DSR is not generation. The value of DSR is unnecessarily limited if forced-fit into generation constructs. This suggests that providing equal access to generation markets is a limiting goal. As examples:

- DSR has unmatched ramping and start-stop flexibility. Moreover, it can compete in load pockets that have defied new generation construction. On the other hand, DSR cannot be dispatched for hours on end. (On this last point, PJM business rules for the Economic Demand Response Program do not allow dispatchable DSR to limit the length of a PJM dispatch. Such DSR rule inflexibility is unnecessary and discourages DSR participation.)
- DSR does not require the lead-time and price floor provided by RPM's four-year ahead capacity auction. Instead DSR is well-suited to expand and contract in response to short-term capacity need.
- DSR values and stabilizes a boom-bust capacity market. DSR derives risk management value from the boom-bust cycle. DSR also caps market prices without regulatory intervention in times of shortage. Likewise, DSR can support prices by acting as the slack variable in times of capacity surplus.
- DSR is a distributed, portfolio resource. It lends itself to estimation and other methods for determining and monitoring real-time performance. So the same, expensive real-time telemetry required of individual central station generating plants may not be necessary for every portfolio participant.

The recently developed PJM business rules for spinning reserve provide an example of business rules not taking advantage of or recognizing DSR attributes:

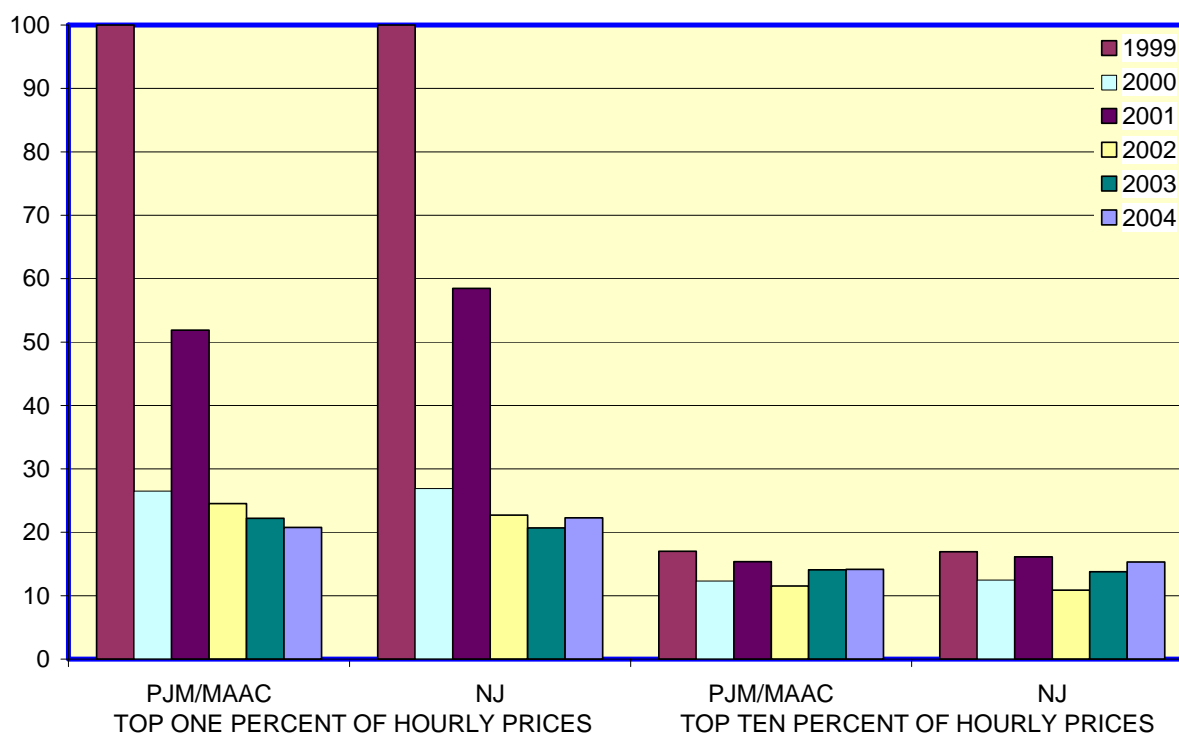
- Much DSR can respond well in advance of ten minutes and ramp to suit virtually any shape desired by system operators.
- DSR providing spinning reserve has capacity value. During the day-time, it can free up generation to serve load.
- DSR should be free to bid whatever the market will bear. A demand-side resource is too small to have market power and so need not be subject to the same administrative burden – to both PJM and DSR providers – of cost-based price caps.
- DSR price bids are limited by PJM business rules to well below the market clearing prices currently set by generators. This illogic is based on the application of generation-based price rules. Generators capture a cost-capped bid price plus opportunity cost. DSR bids are limited to the same cost-capped bid price and no opportunity cost. If cost-capped bid prices for DSR are deemed necessary by regulators, then PJM should develop a cap for DSR that recognizes the higher capital cost of provided spinning reserve from a resource like DSR that is denominated in hundred's of kilowatts, not hundred's of megawatts.

Third, a DSR industry is not financially/economically attractive if focused on the occurrence of dramatically high prices, i.e. around the top one percent of the hours in a few years. DSR aimed at a few high-priced hours on a few hot afternoons in the summer will fail. Such DSR gets out of practice, never gets the practice, or loses interest waiting for those few high-priced hours in those few high-priced summers. DSR cannot be based on the reoccurrence of 1999 energy price spikes (see Figure 3). Such DSR misses most of the opportunity – occurring hourly, daily, and seasonally in every year. Build a dependable DSR industry around multiple opportunities –



Figure 3: Frequency of Dramatically High Prices

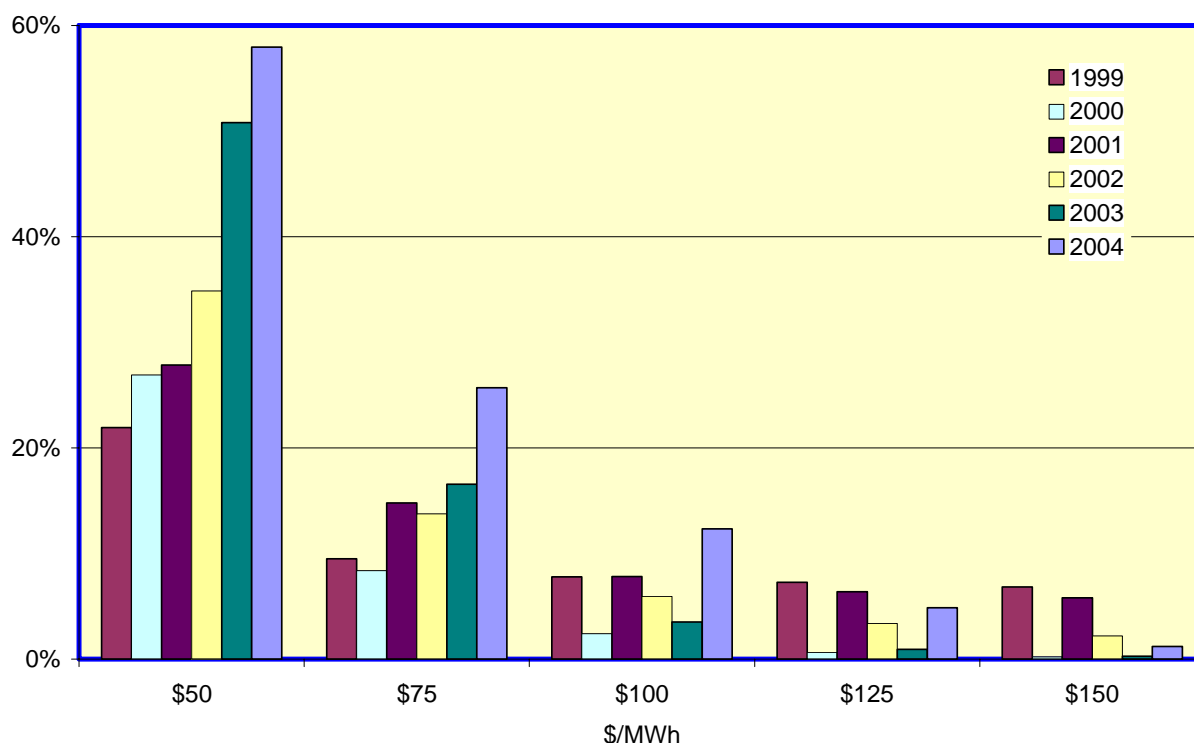
(Average of top 1% and top 10% of LMP prices; normalized to 1999 top 1% = "100")



capacity, energy, ancillary services – and multiple seasons and the more frequent but less glamorous \$100+ prices.

Fourth, DSR has not been proved as an every day reliability resource, for example, for use as spinning reserve or regulation. System operators lack confidence in an unproven DSR. For DSR to be relied on for such purposes, system operators should be at the table defining and advocating control and communications requirements. This did not mean putting expensive meters on every commercial and industrial participant. This may mean investing in a centrally-operated PJM control/communications system for such reliability services. PJM needs a plan, schedule, and budget to make this happen.

Fifth, DSR is a dynamic resource. Its value is revealed through analyses using shapes, probabilities, and correlations. Compelling examples abound in energy, capacity, and ancillary service applications. For example, Figure 4 indicates that LMP exceeded the \$75 threshold in 26% of the large commercial building occupancy hours (8 am to 6 pm) during summer 2004 in eastern PJM (AECO, PSEG, JCPL). By contrast, a less-focused PJM-wide analysis would imply a less attractive 16% summer opportunity. A further generalization to include other on-peak (5x16) hours would imply an even less attractive opportunity.

Figure 4: When can DSR provide the most value?(% of summer commercial building on-peak hours that prices exceed each threshold)

What's needed to foster a DSR industry in PJM?

DSR needs a champion within PJM and formal collaboration amongst DSR constituents around a business plan. Constituents all have to be on the same page, inventing every day, following the money, making mid-course corrections, and figuring out how to make things work.

DSR needs a showcase, for example, a substantive “anchor” program that publicly showcases DSR capabilities and reliability and that provides economies to PJM stakeholders. DSR capabilities should otherwise be articulated in a white paper. DSR capabilities are not broadly understood amongst PJM stakeholders.

Creating a DSR industry through PJM committees is not the answer. The business planning process needs to be collaborative, with everyone at the table aiming in the same direction. Committee members with disparate interests will not foster the same successful DSR industry as would collaboration of DSR constituents around a business plan. On the other hand, successful development of a DSR industry very much depends on PJM – the right PJM programs and business rules, automated operation through an electronic PJM interface, appropriate PJM recognition as a capacity/energy/ancillary service resource, and PJM program continuity sufficient to justify private sector investment.



Recommendation #1: DSR needs a champion and a business plan.

Some group within PJM needs to put their heads together and build a business plan for DSR – with goals, strategy, plan, schedule, and budget. That business plan should then drive and provide context for specific DSR program development in PJM. Some pieces of the business plan already exist. One example is the PJM Industrial Customer Coalition’s (“ICC”) comments of February 10, 2005 to PJM regarding RPM. Another example is PJM’s “Demand Response as Ancillary Services White Paper (Version 1.0) dated November 22, 2004.

The business planning process needs a champion, with capitalization. As a point of reference, consider the man-months of coordination and quality resources that it took to produce RPM. As a second point of reference, consider the multi-hundred million dollar solutions being discussed in RPM meetings. As yet another point of reference, consider that today’s robust generation industry alternately developed, succeeded, and stumbled over several decades under the financial support provided by rate base treatment and fuel adjustment clauses.

Recommendation #2: DSR needs to showcase its capabilities

A substantive DSR “anchor” program would showcase and provide a laboratory for DSR capability; move PJM DSR discussions out of the abstract; and provide the economic scale to support DSR providers through boom/bust markets. Spinning reserve and regulation might provide excellent DSR anchor programs, especially if aimed as part of the solution to the looming capacity shortage in New Jersey.

DSR benefits and capabilities should otherwise be articulated in a white paper. Doing so accomplishes three things. First, it creates a broad understanding within PJM of how and when DSR can contribute to the reliability and economy of the grid. Second, it establishes a rigorous basis for integrating DSR into other PJM planning and operations activities. And third, it provides a basis for setting PJM DSR program development priorities and goals, measuring PJM progress against those goals, and periodically recalibrating PJM expectations and priorities.

Role of the PJM Demand Side Response Working Group (DSRWG)

The DSRWG cannot be the champion. At RPM meetings, stakeholders discuss multi-hundred million dollar solutions to a looming capacity shortage in New Jersey. At DSRWG meetings, stakeholders discuss much less weighty matters. There are two reasons for this disconnect. First, unlike the utility curtailable/interruptible/TOU programs in the past, PJM is not charged with establishing and achieving DSR performance goals. Instead, the PJM and the DSRWG seek “equal opportunity” for DSR by sponsoring PJM and Reliability Council business rule changes. Second, the DSRWG is comprised of PJM stakeholders with disparate interests, appropriately protecting those interests. So while the DSRWG discusses the nature of future replacement programs, it is simultaneously considering proposals to roll back the existing programs. And while DSR advocates believe that the DSR industry must be able to develop independent of LSE’s, PJM supports an LSE right to contractually limit its customers’ participation in third party DSR products and services.

RPM – a Case Study

RPM provides a convenient case study to which the foregoing discussion and analysis can be applied and clarified. The RPM proposal and the RPM Stakeholders Conferences in February



reinforced the need for a DSR champion and for a DSR business plan. There was dramatically increased mention and support for DSR in the recent RPM debate in May at the PJM Annual Meeting. This provoked discussion on how to instill confidence in system operators regarding DSR reliability and capability.

RPM is a major, long-term overhaul of PJM capacity markets. It addresses several compelling needs – generation retirements and shortages in load pockets (especially New Jersey), a too short generation planning horizon, and a boom/bust market cycle that makes generation difficult to finance. While DSR can contribute significantly to the solution, it received little mention in the RPM White Paper or at the February RPM conference.

The RPM white paper cites “... the current lack of demand-side response ...” This is a fair assessment of the DSR industry’s current standing in PJM and is borne out by the aforementioned Market Monitors Report. Going forward, this is a questionable and potentially expensive assumption for all PJM stakeholders. Many very knowledgeable and experienced people are working very hard on DSR technologies and businesses that could undermine that assumption in the future, certainly within the time horizon of a four-year-ahead capacity auction proposed by RPM. This analysis in this paper has also indicated a large, but largely untapped DSR opportunity.

The RPM proposal simply reflects that the fact that the DSR industry has not made its case. This starts with a DSR business plan that should then be reflected in an RPM proposal.

At the February conference, an RPM advocate cited an “improved opportunity” for DSR. Certainly, locational capacity markets are an improvement and should promote DSR where traditional generation cannot be built. However, absent a business plan against which to judge DSR performance, “improved” is in the eye of the beholder. When judged against the DSR business plan revealed (in part) in this paper, RPM underuses and retards the development of DSR:

- Unlike generation, DSR can shape its capacity around seasonal and daily market need. RPM proposes to eliminate daily and seasonal markets, instead maintaining annual markets only. An RPM annual market means the market cannot capture the economies that derive from this DSR shape flexibility. Stated otherwise, in an annual market, DSR is limited to responding to average annual capacity prices.
- Unlike generation, DSR will continuously invest and develop, and then have to wait four years before receiving revenues pursuant to RPM’s four-year ahead bilateral capacity purchase or base auction.
- Unlike generation, DSR derives financial risk management value from volatile capacity prices. Moreover, a robust DSR industry would eventually stabilize capacity prices by expanding/contracting in response to such prices, eliminating the need for both regulatory price caps and RPM price floors.
- A four year-ahead commitment in the RPM capacity base auction is inconsistent with the desire for an expanding/contracting DSR. (See also the aforementioned ICC comments.)
- The RPM “fix” to allow load-serving entities (“LSE”) to declare DSR capacity as “interruptible” just before the planning year falls short. This would relieve the LSE of a portion of its capacity obligation. It is not clear what benefit this provides if the LSE has

already met its capacity obligation through bilateral contracts. If the LSE instead is capacity short, then its allocation of RPM capacity resources will be reallocated to others. In either event, this means that DSR will not create real financial benefit, but will instead add an expense burden to LSE's and their customers.

- Finally, RPM is an extremely complex proposal, regardless of stakeholder group. So evaluating the long-term implications for DSR industry development (good or bad) is difficult. Such uncertainty does not inspire DSR investment.

Conclusion

DSR is a largely untapped resource. To realizing its potential, the DSR industry needs to:

- Find a champion;
- Specifically and formally define and advocate a business plan;
- Develop an “anchor” program.
- Evaluate and develop DSR on its merits, not as an alternative form of generation; and
- Obtain sponsorship to fund this effort.

Had all this been in place in 2004, all PJM stakeholders would have more confidence that DSR had been correctly tasked and anticipated in RPM.